

Space and Micro/Nano satellite technologies

1. **Course number and name:** 020SSTES4 Space and Micro/Nano satellite technologies
2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours
3. **Name(s) of instructor(s) or course coordinator(s):** Elias Rachid
4. **Instructional materials:** Professor handouts, Lab and applied work exercises

References:

- Space Mission Engineering: The New SMAD (Space Technology Library, Vol. 28) Paperback – July 29, 2011, by 65 Authors from the Astronautics Community, James R. Wertz, David F. Everett, Jeffery J. Puschell (Editors)
- Space Microsystems and Micro/nano Satellites Zheng You 2017

5. Specific course information

a. Catalog description:

micro/nano satellite mission, orbits design and analysis, subsystem scheme, micro/nano satellite configuration design, system performance determination and analysis, reliability and safety analysis technical processes of the satellite development, attitude system determination and control, design of the micro/nano satellite integrated electronic system, architecture of micro/nano satellite integrated electronic and relevant technical specifications, concept of micro/nano satellite testing description, ground station types and related software's, STK tracker software, design and implement (tabletop) a nanosatellite type Cubesat 1U using commercial components and boards.

b. Prerequisites: (020MC1NI1 Mechanics 1 or 020MC1CI1 Mechanics 1) and (020ELAES1 Analog Electronics)

c. Selected Elective for CCE and EE students

6. Educational objectives for the course

a. Specific outcomes of instruction:

- Analyze Micro/nano satellite mission and design orbits.
- Design micro/nano satellite configuration.
- Develop the technical processes of the satellite.
- Introduce basic conception and modeling technologies for nano-satellite design (CubeSat).
- Determine and controls the attitude system (environmental disturbance, kinematics, dynamics, attitude sensors, actuators, etc.).
- Knowledge of the orbit and orbital motion of a space operations.
- Introduce the architecture of micro/nano satellite integrated electronic and relevant technical specifications of different subsystems.

- Design a micro/nano satellite integrated electronic system, including the on-board computer (OBC) design.
- Describe the concept of micro/nano satellite testing.
- Describes the ground station types (VHF-UHF transceivers, S, X band etc.).
- Become familiar with some software tracker such HRD, STK, innoslate ...
- Design and implement a nanosat (CubeSat 1U) using commercial components and boards.

b. PI addressed by the course:

PI	2.1	2.2	2.4	3.2	5.1	7.1
Covered	x	x	x			x
Assessed	x	x	x	x	x	x

7. Brief list of topics to be covered

- Micro/Nano Satellite System Technology
- Orbital Considerations
- System Engineering and spacecraft Design
- Payload Architectures Sample
- Platform Subsystems Sample
- Fire RS project Lune1 Sample
- Multidisciplinary Design Optimization of a Micro/Nano Satellite System
- Lab sessions covering the following topics:
 - Hands-on STM32 board: basic peripherals and components
 - Write your own ground station.
 - STK coverage analysis, life time analysis, power generation analysis
 - EOS, ADCS simulation.
 - Antenna deployment application using your STM32
 - Defining pc104 pinout for an example Cubesat.
 - Sizing a CubeSat
 - Mass and Power and data budgets
 - Link Budget.
 - Blink led application with actual OBC
 - Innoslate software
 - STK software